Physics Comment

A Southern African Physics Magazine

Issue 1, March 2009

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Inaugural Issue

SOUTH AFRICAN INSTITUTE OF PHYSICS

Physics Comment – Issue 1 – March 2009

Editorial

Welcome to the first issue of Physics Comment (**PC**), a magazine for Physicists in Southern Africa.

The Editorial Committee is Prof. Edmund Zingu (Mangosuthu University of Technology), Mr. Brian Masara (South African Institute of Physics) and Mrs. Claire Lee (University of Johannesburg).

There have been a few Physics related magazines or newsletters in South Africa. The South African Journal of Physics and Meson are two that come to mind. However, most of us are familiar with its last incarnation as the text only electronic quarterly newsletter that was sent out by the SAIP. It is this electronic newsletter that was the inspiration for Physics Comment. The idea for Physics Comment came from Edmund Zingu and it has taken us about 4 years to get it off the ground.

We will be setting up a dedicated Physics Comment website which will allow online contributions and also for browsing and printing of selected articles. The website should be launched with the second issue of PC.

Contributions are welcome from anyone. I therefore take this opportunity to invite all scientists (whether you are an SAIP member or not!) to submit content in the following categories:

- Physics Education
- Industrial Physics
- Abstracts and links to other physics websites, for snippets of international news, technical physics reports and recent research.
- Conferences, scholarships, vacancies, Winter/Summer Schools
- Student related matters and recent SA Theses in Physics
- Letters to the Editor
- Pictures for the cover

Finally, some acknowledgements.

- Thank you to all contributors of content for this first issue.
- Thank you to the editors of the text-only newsletter Patricia Whitelock, Elmarie Mortimer and Judith Ncapayi.

There would not be a Physics Comment without all your efforts.

Jaynie Padayachee
Physics Comment: Editor-in-Chief

A word from the SAIP President

Nithaya Chetty (University of Pretoria)

The South African Institute of Physics has ushered in a new and professional era following the establishment of the Executive Office in January 2008. This followed on the heels of the international panel review *Shaping the Future of Physics in South Africa* report of 2004, which resulted in a number of fundamental recommendations for strengthening Physics in our country. Communicating Physics within the membership of the Institute, and more generally amongst all physicists, scientists, industrialists, policy makers, government officials and members of the public is an important goal of the Institute in this professional era. It is therefore with much pride that the Institute launches this inaugural edition of Physics Comment, or **PC** as it is being called. I am delighted that Dr Jaynie Padayachee and her excellent editorial team have taken on the responsibility of managing an independent editorial policy for this electronic newsletter, and I am confident that this initiative will grow into a substantial operation into the future. Members now have the opportunity to communicate their news items in a little more detail, with an occasional colour image which will go a long way toward providing useful and timely information, and strengthening the sense of community of physicists in our country and beyond.

The 2008 De Beers Gold Medal: Prof. Krish BHARUTH-RAM

The 2008 De Beers Gold Medal was awarded to Prof. Krish Bharuth-Ram at a SAIP De Beers banquet held at Polokwane on Friday, 11 July 2008. Mr Manne Dipico, former premier of the Northern Cape, made the award on behalf of De Beers.

Figure 1: Prof. Krish Bharuth-Ram was awarded the 2008 De Beers Gold Medal, the highest honour that the South African Institute of Physics can confer.

Krish, as he is called by his colleagues, The Professor, as he is called by his students, was awarded a PhD degree from the University of Oxford. His research subject, experimental nuclear Physics, formed the basis of a superbly successful career as a University teacher, researcher and manager covering the span of nearly forty years.

Krish is an excellent physicist and experimentalist. He has the ability to take the right steps in the design and analysis of experiments. He is well-known as an expert in Mössbauer spectroscopy and has championed the development of this technique in South Africa. Over the years he has constantly sought opportunities to apply this technique to specific South African research problems involving defects in diamond and related materials. With his strong background in nuclear Physics he has broadened his research base to include Solid State Physics, thereby establishing himself as a pioneer in the new field now known as nuclear-solid-state Physics. He has collaborated to this day with a number of leading research institutions in various European countries. He was a Senior Fellow of the Alexander von Humboldt Foundation, Germany. These activities have generated well over a hundred publications in international science journals and proceedings.

Krish is an inspiring University teacher. He supervised sixteen higher degree students, the majority of which came - at the time - from an underprivileged background. They, and many others he taught in undergraduate courses, chose Physics - and not a financially more attractive subject - as their career. This *must* be attributed to the charismatic teacher that is Prof. Krish Bharuth-Ram.

Krish served for sixteen years as Head of Department and a few years as Dean of the Science Faculty of the former University of Durban-Westville. He has also served on numerous national committees as chairman and was invited to serve on many Organising Committees of International Conferences, at times as Chairman. Needless to say, frequent invitations as a speaker at International Conferences go to his credit.

Krish's unassuming personality - appreciated by everybody who knows him - has earned him unequivocal trust in his managerial skills and scientific expertise. It is also for this reason that he is now holding the position of an Executive Director: National Facilities at the National

Research Foundation.

It is the sum of his activities as teacher, researcher and manager, his unselfish devotion to his students and his steady interest in the development of Physics in South Africa, which has led to the decision by the Institute to confer its highest distinction on Krish Bharuth-Ram.

Prof. Bharuth-Ram will be one of the keynote speakers at the upcoming 54th Annual South African Institute of Physics Conference, to be held in Durban from 6 to 10 July 2009.

Physics for Economic Development

Innovation and Entrepreneurship

Brian Masara *starts his series on developing a culture of innovation and entrepreneurship*

The World Conference on Physics and Sustainable Development (WCPSD) was held in Durban, South Africa in October 2005 to celebrate the International Year of Physics. A set of strategic recommendations to confront sustainable development challenges facing the world was drawn up at the conclusion of the WCPSD. A cornerstone recommendation was, "The establishment of a training programme in entrepreneurship and business skills for physicists". This recommendation arose from the realisation that bridging the research-commercialisation chasm has to be urgently tackled in many developing countries including South Africa.

Considering the importance of innovation and commercialisation of research this regular column in ***PC*** shall endeavour to

- Create a dialogue on innovation and commercialisation of Physics research
- Engender a culture of entrepreneurship and innovation among the Physics community
- Ultimately create a platform to enable and promote innovation and the creation of high tech Physics Small and Medium Enterprises (SMEs)

Some may ask "Why should High–Tech SMEs be promoted?" The answer lies in the fact that if scientists and engineers are given the correct entrepreneurial skills they can turn their research results into small and medium enterprises (SMEs), which will one day grow into multinational corporations. The Asian Tigers in the east as well as Silicon Valley in the west have already proven the fact that SMEs are an engine for economic growth.

Much research has been done which supports the importance of encouraging an entrepreneurship culture. For example, Temtime and Pansiri [2] argue that SMEs are important because they employ more people per unit of investment when compared to large companies. They go on to add that SMEs encourage a culture of saving since money invested in SMEs would have been used for consumption purposes. Baldacchino [1] adds that SMEs support an economic path that is less expensive and more efficient than large companies. He goes on to claim that SMEs are key to economic growth because they create products and services, create jobs, motivate those associated with them to higher levels and reduce dependency on government. Wijewardena and Cooray [3] also recognised that SMEs play a pivotal role in both developed and developing countries representing well over 90% of all manufacturing enterprises in the world.

Innovation Management – from Ideation to Commercialisation

Many innovative physicists use trial and error to commercialise their research ideas because the traditional Physics degree does not contain a business or innovation management component. However progressive universities in the United States have now introduced Physics degrees with a business component. There are many skills that a person who has studied a traditional Physics degree must acquire in order to be effective or become an entrepreneur. These include accounting, marketing, business law, negotiation skills, innovation management and people management.

In this issue I will introduce a systematic process (Figure 1) to innovation management. It has checks and balances to ensure that your product takes the shortest time from development to market launch.

According to the stage gate website www.stage-gate.com "*A Stage-Gate Process is a conceptual and operational roadmap for moving a new-product project from idea to launch. Stage-Gate divides the effort into distinct stages separated by management decision gates. Cross-functional teams must successfully complete a prescribed set of related cross-functional tasks in each stage prior to obtaining management approval to proceed to the next stage of product development*"

In upcoming articles I will discuss each stage of the stage-gate process in detail and describe the activities involved at each stage and gate.

Until next time, happy innovating!

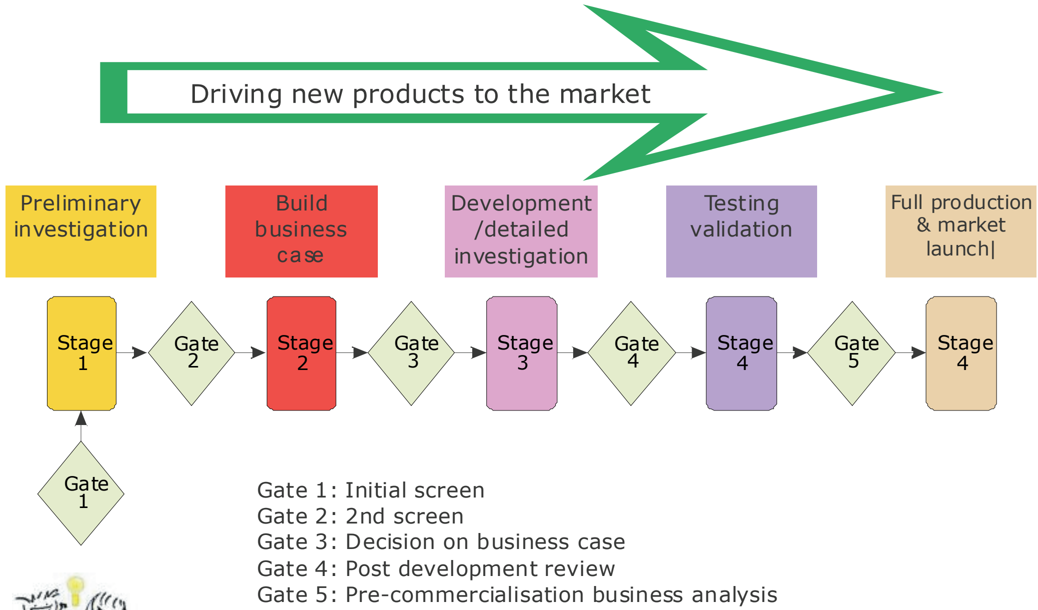

Figure 1: The Stage – Gate Process from Ideation to Commercialisation.

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Techtrack

Explaining science to general public really hard work

Kelvin Kemm

For years I have been involved in the interpretation of science to the general public. This is actually hard work.

Firstly, one has to examine the science and decide what it is that, in my opinion, the public should be told. Now, before there are howls of protest about me being a censor, this is not what I mean.

What I mean, is that if one tries to explain too much too fast, then the result is that one just loses the audience entirely.

I also have to think up analogies, and say that something or other is like a tomato or whatever. A danger lurks!

Once, on TV, I said that the structure of the atom is like a small solar system with the positive nucleus in the middle, and negative electrons going around in orbits, the whole thing being like a ball.

This of course, is what is known as the Bohr Atom, after the famous Danish physicist Niels Bohr. But that model is now out of date. So, when I arrived home after the TV show, my phone rang and a physicist colleague berated me for not telling the truth. He said that I knew very well that the electron clouds are not circular and are described by a chi-squared probability density function, and that atoms are not all symmetrical balls.

Okay…Okay…Okay, so I am supposed to tell a TV audience about probability density functions. Anyway, I learnt my lesson and now I would say: "Although this model is out of date and is known as the Bohr Atom, it will serve our purposes for now." I would then go on with my explanation.

There is a famous quotation that is always misquoted: "A little knowledge is a dangerous thing." That is wrong! The correct one is: "A little learning is a dangerous thing."

Knowledge is never dangerous, but some small amount of learning can be, if the person then thinks that he or she is an overnight expert, because they have learnt a bit about a new topic.

A snag about telling the population about science is if that it is possible to tell them just enough for the information to be dangerous. Einstein said, one can simplify complex science down just so far, but no further than that. I can imagine just how many people asked him to explain his theory of relatively in layman's language. It is very difficult to do this.

Anyway, an amusing story in this vein is the one about the very dangerous chemical, Dihydrogen Monoxide. This stuff, DHMO, kills many people every year, many of whom are children. It is an uncontrolled substance, and any unqualified person with no chemical training can use the stuff, often with disastrous consequences.

There have been petitions to governments to ban the chemical, or at least to put it under strict government control, all to no avail. The reason why governments fail to respond is that DHMO is plain and simply ordinary water, normally written chemically as H2O.

I first came across this story years ago, when a friend of mine Dr Roger Bate of Cambridge University at the time was plotting, with a few others, to launch a campaign in London. He wanted to see how many people would sign a petition to ban or control DHMO. I watched the saga unfold in real time.

As I recall, more than half the people signed. Roger's team handed out pamphlets in the London underground and other places. The objective of the exercise was to show that in good faith the public will endorse some scientific nonsense that they do not understand.

So, at times public endorsement of some technical issue means nothing. In fact it can be positively damaging. The DHMO saga had started in 1989, when Eric Lechner, Lars Norpchem and Matthew Kaufman, three students at the University of California circulated a flyer about the problem chemical.

By 1998, Tom Way had created a hoax website about DHMO. People fell for the hoax in droves, proving the point. In 2001, Sue Kedgley, a Green Party MP in the Parliament of New Zealand, responded to a request to ban the chemical, saying that she was: "absolutely supportive of the campaign to ban this toxic substance."

The opposition National Party jumped on her in glee, but six years later one of their own MP's fell for the same hoax. In the US the DHMO story was featured on the TV Program "Penn and Teller: Bullshit." Penn and Teller are two magicians who host the show. It sets out to debunk pseudoscientific ideas and misconceptions.

Peter Sparber, a Washington DC business lobbyist, who regularly clashes with extreme environmental groups, also tried his hand at the hoax. He sent out letters of appeal to many people, and pointed out that some fictitious company was producing DHMO.

Replies sent to the fictitious company included: "What is going on here? You people must really believe the world will come to an end in the year 2,000. Why else would you be poisoning the planet and its inhabitants with dihydrogen oxide?" "Stop the production of dihydrogen oxide! Dihydrogen oxide has been found to be a major threat to the environment and to human and animal health, and yet you continue to produce it!" "Please stop all production of dihydrogen oxide until such time as we can all be assured that it is safe to humans, animals and the environment." "Any product that causes injuries and death, as well as pollution, should not be used. Thank you."

See how public opinion can be formulated along a crazy pathway.

Techtrack appears each week in Engineering News (www.engineeringnews.co.za). It has been reprinted here by permission of K. Kemm. This Techtrack appeared in Engineering News, Vol 28 No 36 19-25 September 2008).

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Physics Education

The first National Senior Certificate Examinations and Physics teacher development

Diane Grayson

In 2006 the new National Curriculum Statement (NCS) was introduced into Grade 10, in 2007 into Grade 11 and in 2008 into Grade 12. Some of you will remember that for several years before that we in the SAIP made a number of comments and suggestions about the Physics component of the NCS. In the final version that was implemented, many of our suggestions were taken up. As a result, a number of physicists feel that if students understand the Physics in the NCS they will be much better prepared to deal with university level Physics than in the past. The curriculum can be downloaded from:

http://www.education.gov.za/Curriculum/SubjectStatements.asp.

In 2008 the new school-leaving examinations, the National Senior Certificate (NSC) exams were written for the first time. The Physics exam and memo can be downloaded from:

http://www.education.gov.za/Curriculum/NSC%20Nov%202008%20Examination%20Papers.asp.

Although there is always room for improvement, as a Physics community we should be reasonably happy with the overall standard of the paper and the variety of question types. Unlike matric papers in the past, students would not be able to do well in this exam simply by plugging numbers into equations. I believe that as the SAIP we have been able to make a useful contribution over the past few years to the Physics that is now being taught and examined at school level. We have a very good relationship with the national Department of Education, and our expertise is valued.

Figure 1: Diane Grayson (right) at a teacher training workshop.

An area in which we can make a great contribution is to help teachers and subject advisers deepen their understanding of the Physics content of the new curriculum. Some parts of the NCS were written in such a way that there is a clear link with university Physics. For example, when students learn about the relationship between electric current and magnetic fields, including the Lorentz force, they learn only the right hand rule. Apart from reducing the number of rules they have to learn, this approach also prepares them for cross products if they study more Physics later on. However, this approach is new to teachers, so they need help understanding it. Since 2005, Physics lecturers have come together for several workshops, funded by the Department of Science and Technology (DST), to explore ways of helping teachers understand and teach the Physics in the NCS better. In the last workshop lecturers developed materials that can be used by any Physics Department in courses for teachers.

This year the SAIP has received its last payment from the DST's Educator Support Programme. We have submitted a proposal to DST to use this money to run 7 regional workshops for subject advisers. The Education sub-committee of the SAIP Council will be approaching Physics Departments to make contact with subject advisers from their regions. We will provide their names and contact details. The idea is to run an initial workshop with subject advisers on sections of the curriculum that are new or conceptually difficult. After that, we will ask Physics departments to liase with subject advisers in order to run courses for teachers that will increase their Physics knowledge and related skills. Our suggestion is that the subject advisers recruit the teachers and pay for the courses from their skills development levy. Ultimately, we would like to see every Physics Department offer courses (not just one-off workshops) for Physical Science teachers. Since the provincial Departments of Education will pay for these courses, it should be possible to hire lecturers to run them. Also, we hope that lecturers developing these courses will build on the materials developed so far, and share what they develop with other departments. Such courses will fit into the government's framework for teacher education, gazetted in 2007, which requires teachers, like other professionals, to acquire Continuous Professional Development credits.

Diane Grayson is a Physics Education consultant and can be emailed at dgrayson@absamail.co.za.

The South African Physics Graduates Database

Brian Masara

The problem faced by South Africa is that there is an ageing and shrinking physicist population, which is not representative of the country's demographics. This implies that South Africa will not be able to staff big Physics initiatives (such as SALT, SKA and the PBMR) in the near future, thereby adversely affecting the underlying economic and technological growth of the country.

The problem starts at the Grade 12 level and is propagated upwards. For example if one considers that Mathematics is a prerequisite for Physics one finds that there is a dismal performance in this area. According to 2004 Grade 12 results (Figure 1), only 2400 black students passed Mathematics in the higher grade.

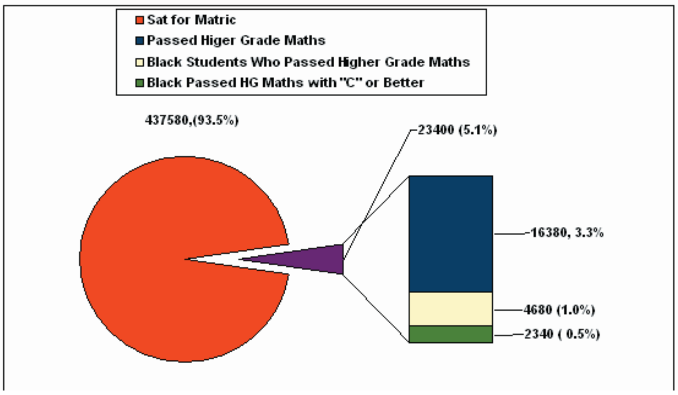

Figure 1: 2004 Mathematics Grade 12 results

One can get an upper limit to the estimate of the number of students that will possibly choose

Physics at university by assuming that the 2400 students are divided equally amongst the 20 South African universities. These approximately 120 students per university then have to be allocated to four faculties, Medicine, Natural Sciences, Engineering, and Economics, i.e. there are at most 30 per faculty available. In the Natural Sciences the division is (typically) between, Biology, Chemistry, Mathematics, Physics, and Computer Science, which leaves an average upper limit of 6 first-year students per year for Physics. In reality it is less because Engineering, Medicine and Economics are more popular than Physics.

The low Grade 12 pass rate impacts at university level because according to a report in the South African R&D Strategy (2002), black and women scientists are not entering the academic ranks, and the key research infrastructure is composed of people who will soon retire. Figures 2 and 3 show the severity of the problem.

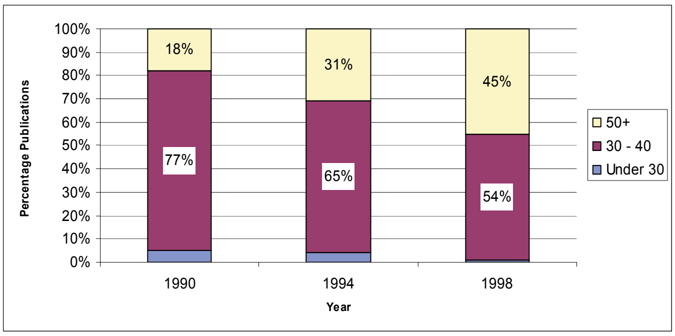

Figure 2: Percentage of publications by age

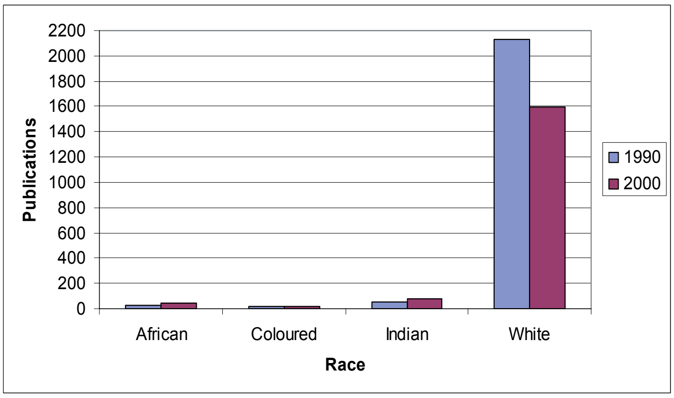

Figure 3: Publications by race

Proposed Solution: A Decision Support System

In order to effectively analyse and solve the problem, accurate statistics are required that show previous trends, current trends and can predict future trends in the production of Physics graduates. The accurate statistical information can then be used to develop a decision support system for all Physics stakeholders, including Government, so as to inform policy and funding decisions.

The South African Institute of Physics in collaboration with the National Research Foundation is developing a database system to capture the statistics of Physics graduates in South Africa.

The SA Physics Graduates Database is a web-based facility that will be used to record past, current and future Physics graduates in South Africa. It is anticipated that the database will address the following priority needs:

- Accurate statistics to track Physics graduate production
- A decision support system for Physics to support decision making by Universities, DoE, DST, NRF and all Physics stakeholders such as SALT, PBMR, SKA, etc
- Physics recruitment database for large national Physics projects and private sector
- Increasing number of physicists with respect to demographics

Confidentiality

Information on the database will always be treated confidentially and will only be made available to selected people. Participants can choose whether or not they want their details to be circulated to interested parties by answering the following questions:

- Would you be interested in mentoring young Physics graduates?
- Would you be interested in referrals for consultancy?
- Would you want us to give your personal details to prospective employers?
- Would you like to further your studies (Honours, MSc, PhD or Post Doc)?

Development

The first phase of development on the SA Physics Graduates Database has been completed developed and testing is underway. There will be two methods of registration:

- *Batch Registrations*: Physics Departments can batch register Physics graduates at the end of each academic year. Registered graduates can then log on to the Database and update their personal details.
- *Individual Registrations*: Individuals can create their own entry on the database.

Launch

The SA Physics Graduates Database will be launched to the Physics community and Physics stakeholders in the second quarter of 2009. Technical support will be provided by the SAIP Office.

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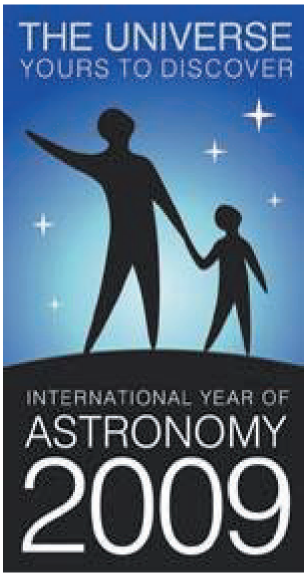
400 Years of Telescopic Observation

The International Year of Astronomy

Robert Groess



When we think of the time Einstein lived in, we have some sort of semblance that it was not all that long ago. The turn of the 20th century is something that we can, in a limited way, relate to. Aeroplanes. Refrigerators. Radio. Television. These are the products of Einstein's era. But when we talk about Newton, Kepler, Galileo and Copernicus, we find it far more difficult to imagine what the world was like during their life-times. Four hundred years ago, automobiles were further removed from reality than their clunky predecessors are to us today. This was a time when there were only five planets and the heavens revolved around an immutable Earth. There was not an inkling of the notion that our solar system contained more than five planets (six, if you include the Earth), let alone that we belong to a galaxy in an expanding universe and that there are billions upon billions of other galaxies within our observable horizon. This was the world in which Nicholas Copernicus (1473-1543) and Galileo Galilei (1564-1642) lived. And it is in this world that their musings upon heavenly phenomena changed the way our universe is perceived forever.

Contrary to popular belief, Copernicus' first ruminations about the true position the Earth held in the feeble cosmology of the 16^{th} century were met with great enthusiasm and interest from many senior establishments of the day. Even the veritable Roman Catholic Church, which oblivious to the turn of events which would soon send it careening to becoming the ultimate villain in much of the 500 years of science history which followed, was very open and accepting of a heliocentric Copernican universe with the Earth a faithful subject orbiting a nearby luminous star. This train of thought quickly gained much popularity in the Europe of 1500 still emerging from the throes and shackles of medieval thought, where Copernicus' own *De Revolutionibus* was read and taught at leading Catholic universities for at least 60 years after Copernicus' death. So why then do we have a very different account of history from just after this era? And why has none been seen to be at the centre of this controversy more than Galileo himself?

The answer may lie in the growing theological difficulties, which were sought to being reconciled with a literal interpretation of the Copernican view, which at about the time that Galileo pointed his humble 'spyglass' skyward, had almost reached crescendo. Made of nothing more than a tube of lead, with two lenses embedded, one a plano-concave, the other a plano-convex lens, his first attempt at a telescope magnified objects to look about three times closer and nine times larger. Far from competing with even simple telescopes of today, it is what Galileo did with his version of the telescope that changed the world.

Witnessing first hand the orbital motion of the moons of Jupiter, Galileo was hard pressed not to accept the fact that bodies orbiting other bodies in the universe were perhaps more common place than most gave the idea credit for. Armed with this burgeoning evidence, Galileo stood resolute in the provocative Copernican insinuation that the Earth was not the centre of the universe and that it instead moved around the sun as did the other planets. His seminal work, *Siderius Nuncius* (the Starry Messenger) was subsequently published in 1610.

Leading scholars of the Protestant Church however, reacted by vehemently protesting against such heretical contemplations. Central to their contestation was not the idea that a heliocentric universe would 'dethrone' humankind from a preferred position, but rather, according to Dennis Danielson, that the grotesque and repugnant Earth, to which "the excrementary and filthy parts of the lower world" coalesced, was now exalted to a 'higher' position. It was this consternation instigated by the Protestant Church, which led the Roman Catholic Church to effect an abrupt change in policy in 1616, from the tolerance of this new skein of thought to its disarticulation. Galileo however, never fully accepted this repression and even in 1633 in the days leading up to his house arrest in the face of public ridicule and persecution from the mighty Roman Catholic Church, refused to completely recant his convictions. So powerful was the edict enforced by the Roman Catholic Church upon Galileo that the charges against him were only removed by Pope John Paul II in 1992.

With such a rich and powerful history, it is Galileo and his humble 'spyglass' that we commemorate some 400 years after his first tentative observations of a universe prolific in orbital motion. In an unprecedented international initiative, numbering 137 countries at the time of going to print, the International Year of Astronomy 2009 (IYA2009) is coordinating key projects around the world to bring astronomy awareness to the masses. Projects such as getting 1,000,000 people to look though astronomical telescopes over the course of the year, and the 100 Hours of Astronomy project from 2 - 5 April 2009 all serve to inject an enthusiasm into an activity which, 400 years ago, rocked the very core of human contemplation.

The South African Node of IYA2009 is headed up by single point of contact, Mr. Kevin Govender, at the South African Astronomical Observatory headquarters in Cape Town. Professionals and amateurs alike, from various universities as well as the Astronomical Society of Southern Africa, have been called upon to contribute and coordinate events in and around their home centres/institutions. Updated listings of current events and links can be found on the South African IYA2009 website:

http://astronomy2009.saao.ac.za.

Dr. Robert Groess is at the School of Computational and Applied Mathematics of the University of the Witwatersrand and is Chairperson of the Johannesburg Centre of the Astronomical Society of Southern Africa . He may be contacted at groess@gmail.com.

The State of Synchrotron Research in South Africa

Brian Doyle

Synchrotron radiation is the well-known physical phenomena whereby charged particles that accelerate in a magnetic field emit radiation. Originally observed as a limiting factor in beam energy in particle Physics colliders (or synchrotrons) this effect is now used in purpose-built facilities worldwide. When the charged particles, usually electrons, possess relativistic energies the radiation that they emit in a magnetic field is peaked in the forward direction. Coupled with specially designed arrays of magnets the emitted intensity is greatly enhanced with the beams of radiation produced being by many orders of magnitude brighter than mankind is able to produce. Amongst its more useful properties this light is of low divergence, the polarization can be adjusted from linear to circular, it can be pulsed for time-resolved studies and is widely tunable across almost the whole of the electromagnetic radiation spectrum, from the infrared (IR) and ultraviolet (UV) to soft and ultimately hard X-rays up to hundreds of MeV.

These properties make synchrotron radiation sources the most powerful modern multi-disciplinary scientific instruments. They are single research tools, able to provide a variety of effective radiation probe techniques to address topical problems in a wide spectrum of disciplines. There are presently close to 60 synchrotron radiation sources in operation or under construction in the world today [1]. The high photon flux provided by what are known as 3rd generation sources along with major advances in detector technology and data analysis allow significant advances to be made in numerous research fields, and in many cases have resulted in a revolutionary impact. Originally the domain of physicists and chemists, synchrotron radiation based research has spread across almost all scientific fields. Amongst the disciplines to benefit are materials and nano-science, the life sciences, mining technology, and earth, environmental and heritage sciences. Significant examples include drug development and better understanding of diseases based on protein and viral structures, new models of deep earth dynamics from experiments conducted at pressures approaching those present at the core, and advances in data storage through studies of electronic structure and magnetism. Greater understanding of the properties of materials and processes such as stress and strain now allow new materials with enhanced properties to be developed. Great promise is also being shown in direct medical applications, with innovative imaging techniques, for example of the heart, lung, brain and in mammography, now being complemented by new therapies. More recently the fields of heritage and palaeontology have benefited greatly from, amongst others, the possibility at synchrotrons to generate three-dimensional images of objects such as fossils and bones.

An integral part of the already established South African Synchrotron Roadmap [2], with the goal of increasing our synchrotron capacity in South Africa, is to increase the number of researchers who know about and have access to synchrotron radiation facilities. To this end, Science at Synchrotrons [3], the second in a series of meetings focusing on the research possibilities at synchrotrons, was held in the second week of February at the Department of Science and Technology (DST) campus in Pretoria, more than capably organized by the SAIP Office. This follows a very successful and similar series held in the Cape at iThemba LABS in February 2007. 27 international experts were present, both to give lectures on a diverse number of topics and to hold mentor-mentee sessions with South African students to determine how synchrotron radiation can best be used to help resolve their particular scientific problems.

A number of senior representatives of the French, Italian and European synchrotron radiation facilities were amongst the international lecturers in attendance and productive meetings were held between them, SA scientists and representatives of the DST. Amongst the matters discussed were easier access to travel funds to access synchrotron radiation facilities and the drafting of a memorandum of understanding between the French synchrotron community and South Africa. DST's support of the conference itself extended from substantial funding to providing state of the art conference facilities. The Minister of Science and Technology, Dr. Mosibudi Mangena, was the guest of honour at the conference dinner.

So what is the state of synchrotron radiation research in South Africa? Over the last 5 years a total of 51 scientists and students have accessed these facilities for their research, resulting in 6 Doctorates, 5 Masters and 17 refereed publications thus far. However the 15 experiments carried out by South African researchers in 2008 pales next to the 4200 experiments carried out at the European synchrotron ESRF [4] and the French synchrotron SOLEIL [5] during the same period. Nevertheless synchrotron usage by South Africans is accelerating and comparison with the paths previously taken by scientific neighbours such as Australia and Brazil, is favourable. A possible next step, one which was of key importance to a number of countries before they built their own synchrotrons, would be to acquire or build one or more South Africa instruments (known as beam-lines), at existing synchrotrons. Apart from the evident technical know-how that we would gain, this would greatly simplify South African access to these powerful facilities. The end-goal of the roadmap would be, in 8 years or so, to complete the feasibility study for a synchrotron to be built in South Africa. This would be the first of its kind on the continent, and would serve as a beacon of scientific excellence for all of Africa.

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4. http://www.esrf.eu
5. http://www.synchrotron-soleil.fr

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Introducing Hermanus HE13N (34.4°S, 19.2°E)

A new Southern Hemisphere Ionosonde Station in South Africa

Lee-Anne McKinnell

The Hermanus Magnetic Observatory (HMO) in Hermanus, South Africa is pleased to introduce the fourth ionosonde in the South African network, located in Hermanus (34.4°S, 19.2°E). An ionosonde is a type of High Frequency radar, which is used to measure the bottom side (90 to 350 km) ionosphere. On 3 July 2008 the first ionogram, shown in Figure 1, was produced using the new sounder. The sounder is a new model Digisonde, a DPS-4D, purchased from the University of Massachusetts Lowell Center for Atmospheric Research (UMLCAR) and the Hermanus station is the first in the world of the new model DPS-4D to be operational in the field.

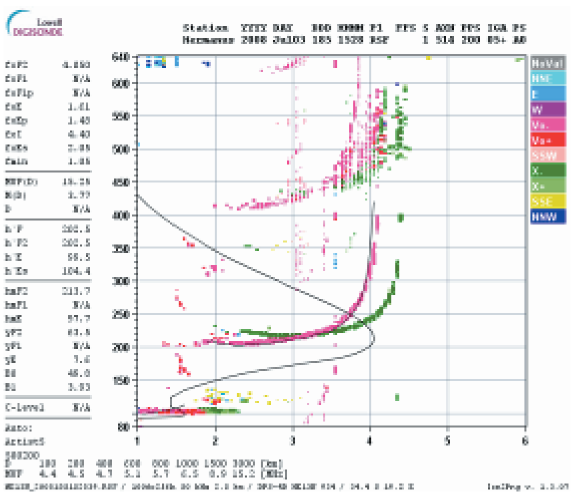

Figure 1: The first scaled ionogram obtained at 15h28 UT on the 3 July 2008 from the new DPS-4D operating at Hermanus, South Africa

This station joins the Grahamstown (33.3°S, 26.5°E), Louisvale (28.5°S, 21.2°E) and Madimbo (22.4°S, 30.9°E) stations in the South African network, and covers the Western Cape region as well as some of the Atlantic Ocean area. Figure 2 shows a map depicting the location of the stations within the South African ionosonde network. All 3 of the older Digisondes are Lowell DPS-4 models, with Grahamstown operating since 1996, and Madimbo and Louisvale since 2000. At the Grahamstown station a Barry Research Chirpsounder operated prior to the installation of the DPS-4 and so there is a database of ionospheric data for Grahamstown going back to 1973.

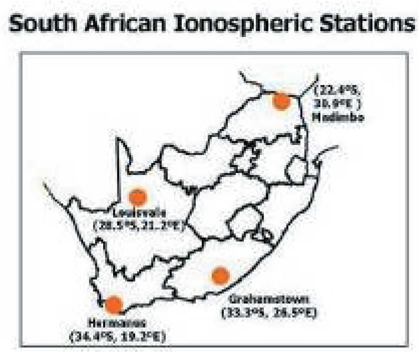

Figure 2: A map of South Africa depicting the location of the four ionosonde stations.

There used to be an IPS-42 ionosonde in Hermanus in the late 80s and early 90s, however, it was completely dismantled when the station lost its funding in 1993. The new ionosonde has been installed on the same site as the previous ionosonde, although the current installation was treated as a new installation due to the fact that no infrastructure remained after the dismantling of the previous ionosonde. The older data from Hermanus is only available in a printed format; however, the HMO is undertaking efforts to put this data into an electronic format.

The ionosonde antenna layout consists of a 30m vertical transmit antenna and a separate receive array consisting of 4 cross loop antennas. Figure 3 shows some photographs of the newly installed station in Hermanus.

The new Hermanus ionosonde was donated by the South African Department of Communications and will be operated and maintained by the HMO. It is currently running a 15 minute vertical incidence program with each ionogram immediately followed by a fixed frequency drift scan. All data is currently being archived together with the rest of the South African data, and is being sent in real time to the Digital Ionogram Database (DIDBase) in Lowell, USA. Plans are underway to also send the data in real time to the World Data Center. At the moment the latest ionograms can be viewed on the HMO space weather website [1] together with the ionograms from the rest of the network. Data is also available from the 3 older ionosondes [2] and future plans include making the Hermanus data available there as well.

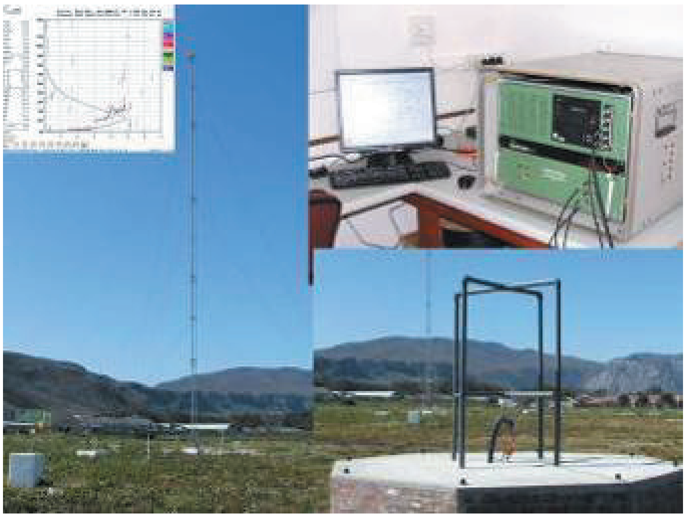

Figure 3: The newly installed Hermanus ionosonde consists of a transmit antenna (right), four cross loop receive antennas (bottom left) and the DPS-4D located inside a nearby building (top left). A recent ionogram is shown as an inset.

References

1. http://spaceweather.hmo.ac.za
2. http://ionosond.ru.ac.za

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The South African National Grid

A perspective on a new dawn for scientific collaboration in South Africa and beyond.

Bruce Becker

Few would disagree that we stand at an exciting time in Physics. The commissioning of the most powerful accelerator ever built – CERN's Large Hadron Collider, or LHC – last year brought with it an increased level of interest scientific discovery probably on a par with the moon landings in 1969. Some physicists in (and outside) the field expect that the results, which will be obtained from the experiments that will be measuring the products of the collisions, produced at the LHC to provide a fundamentally different understanding of the nature and behaviour of the basic constituents of the universe. While this may be an overly ambitious or prophetic expectation, the reality is that the LHC is a machine for discovery and we only have our best guesses to guide our expectations. It is this knowledge - which are at the limits of knowledge itself - that stimulates such public interest and sustained scientific endeavour, that heightens the excitement and sense of participation in something, which would otherwise be considered a sterile "academic" pursuit.

The Large Hadron Collider is often discussed in the popular press as "the biggest experiment on earth". It would be more accurate however to describe it as the biggest scientific instrument on earth. The experiments themselves – ALICE, ATLAS, CMS and LHCb – are the real purpose for the LHC, for what point is there to creating a big bang if there is nothing there to see it? Indeed, the size, complexity and accuracy inherent in these detector-facilities would be hard to swallow for the physicists and indeed engineers of just a few decades ago. The questions to which these experiments seek clues - the origin of matter and antimatter, the arrow of time, the origin of mass, the nature of nuclear confinement and the state of the early universe from which our current one descends – imply a new scale of Physics, a new scale of collaboration and a new scale of global participation in the search for these answers.

The collaborations of physicists and engineers, which have formed around these experiments, have memberships of the order of thousands of people and budgets running far into the tens of millions of Euros. Experiments at other accelerators that lead up to those at the LHC, such as the Relativistic Heavy-Ion Collider (RHIC) at Brookhaven National Laboratory (BNL), the Tevatron at Fermilab, the West-Area (WA) and North-Area (NA) series of experiments at CERN's Super Proton Synchrotron and not to forget of course the experiments at the Large Electron-Positron Collider (LEP – which was re-used by CERN to provided a significant amount of infrastructure and facilities to the LHC, including the accelerator tunnel and several experimental halls) pushed the boundaries of Physics and technology. However, it is with the LHC that we see a qualitatively different regime. When experiments consist of thousands of people in countries on most of the world's continents, when data is being read from the detectors at speeds of GB/s and has to be processed in real-time, when annual data taking sizes are large fractions of an Exabyte, then it is financially impossible in practice to centrally store, manage and process the data from a single facility such as CERN. It is in this expected explosion of data and the widely distributed nature of the collaborations, that the concept of grid computing found its natural home. The combined resources committed by the computing centres of the participating institutions of each experiment, operating in a coordinated and well-controlled manner, provide the aggregate computing power and data storage capacity necessary to support the massive amounts of data being taken.

This global and fully connected nature of the participating institutions in LHC experiments is especially relevant to the South African research groups taking part in two of them: ATLAS and ALICE. Although the South Africans physicists in these experiments may be far from the actual source of data and detector hardware, as members of the collaboration they have the right and responsibility to access and analyse the data obtained. The only way in which to perform this access and analysis is a grid. Indeed, participation in ATLAS (A Toroidal LHC ApparatuS) by South African physicists came about through collaboration of the University of Johannesburg, the University of Columbia in New York and was extended to include BNL in 2007, via the Open Science Grid in 2006. The experience at the University of Johannesburg echoes a similar process begun in 2002 by the UCT-CERN Research Centre at the University of Cape Town, working with the ALICE (A Large Ion Collider Experiment) data grid in order to host a computing centre in Cape Town to support participation in that experiment (Figure 1).

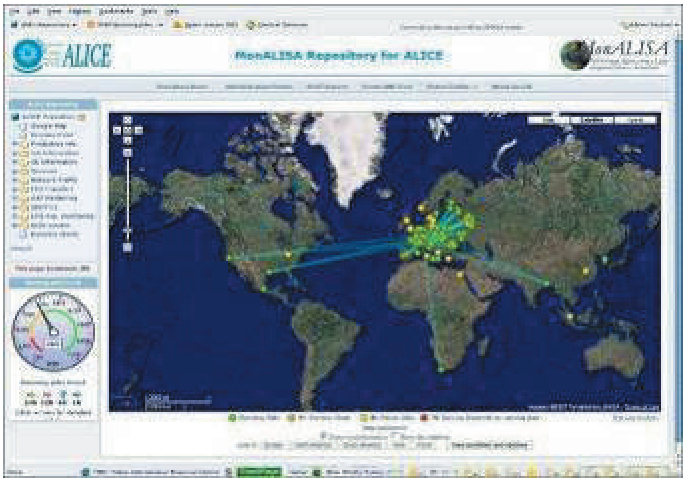

Figure 1: A screenshot of the ALICE monitoring web page showing data transfer and running jobs at the UCT-CERN Research Centre as part of the ALICE DataGrid (http://pcalimonitor.cern.ch)

The model of a data grid which has been developed by the LHC experiments, in the context of the LHC Computing Grid (LCG) is one of *Tiers*, as shown in Figure 2. A hierarchical organisation of computing power and corresponding levels of service and support requirements has been implemented in order to ensure that the data obtained at CERN is reliably transported and automatically processed at each stage, to provide the end user with the most useful format of data to work with, containing just the right amount of information to perform a Physics analysis. *Tier 0* is associated with the source of the data, and as such is unique. Several *Tier 1*'s are represented by the large national computing centres, such as the INFN's CNAF in Bologna, the IN2P3's Centre de Calcul in Lyon, the GSI's Forschung Zentrum Karlsruhe (FZK), Rutherford Appleton Laboratory (RAL) in the UK and other centres with of the order of a few 1000 cores or more of computing power. At these sites a copy of the raw data is kept and the first pass of automated reconstruction is performed, after which a more condensed version of the data, perhaps containing only some summarised version of the full results, is produced and sent to the *Tier 2*'s. These Tiers are typically large institutional computing centres with several hundred (in some cases up to O(1000) cores). The analysis of the data by physicists is performed here in a massively distributed way (consider only the fact that the Tier 2 sites are distributed around the world from Berkeley to Mumbai) is performed here, thanks to the grid's data management system. The grid middleware used by the experiments allows the members of the experiments to leverage, without actually knowing the details of each individual site (its location, characteristics, etc) the entire global computing infrastructure as if it were a single resource.

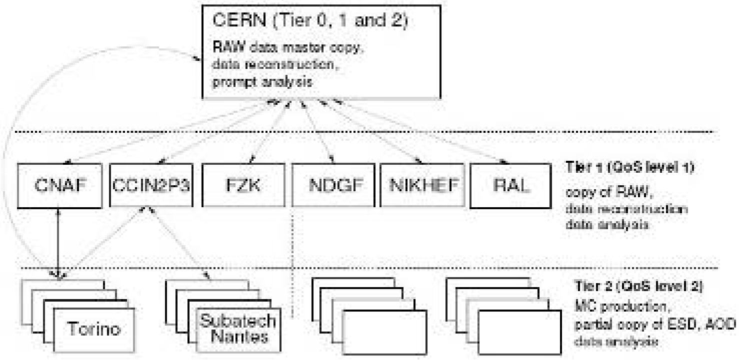

Figure 2: Tiered model of grid sites as implemented by LCG, showing Tier 0 at CERN, Tier1 at the dedicated experiments is one of Tiers, as shown regional sites and several Tier 2s

Of course, many were sceptical that this new paradigm in computing – something so essential to the success of the experiment – would actually work. For this reason, several readiness tests were performed to simulate the behaviour of the grid in the data-taking environment. In the absence of real data from the experiment, a large fraction of the expected data sample is simulated over a period of months and the entire data chain is reproduced in a massive dress rehearsal. Figure 3 shows the real data rate from cosmic events taken pumped through the ALICE grid over the last year. These so-called Service Challenges or Physics Data Challenges were performed once a year from 2002 to 2007 and then continuously from 2008 to the present. They have conclusively shown that the global computing infrastructure of the experiments works and provides the functionality required for the experiment to be a success. The UCT-CERN Research Centre has since 2003 taken part in a small way to the ALICE data challenges, hosting Physics simulation production jobs, which are then sent back to the central storage at CERN. While in principle a success in the sense that ALICE jobs actually ran in Cape Town and the site is visible in the ALICE data grid, the usefulness of the facility in Cape Town to the collaboration was severely hampered by two issues which may be summarised as one: *infrastructure*. *Hard* infrastructure in terms of hardware and *soft* infrastructure in terms of organisation.

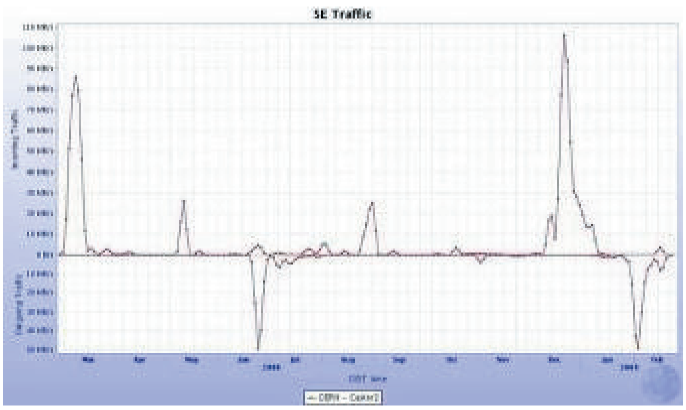

Figure 3: Data rates to and from the ALICE central storage at CERN over the last year. Much of this data is real Physics data from cosmic events.

The problem of cyber infrastructure in South Africa is well-known to all scientists and is being addressed since 2005 by the DST's national cyber infrastructure plan. This includes of course the Centre for High-Performance Computing (CHPC) in Cape Town and the South African National Research Network (SANREN) (see Figure 4). These initiatives address in a significant way the lack of hard infrastructure, but do not adequately provide the *soft* infrastructure. This *soft* infrastructure – strongly emphasised at the recent launch of the SA-CERN Consortium in December 2008 by the Director-General of the Department of Science and Technology, Dr. Mjwara - includes the layer of middleware and human networks, as well as the crucial security infrastructure required to take full advantage of the significant investments.

For historic reasons, each experiment embarked on its own specific set of tools for the grid middleware, since most included collaborations from both the Americas and Europe, where essentially two different paths were undertaken towards developing the services that would comprise the grid. Figure 5 shows the timeline of these the significant developments worldwide. While in Europe, efforts led by CERN to produce a single middleware for the LCG, eventually culminating in the EU project Enabling Grids for E-SciencE (EGEE), efforts in the US focussed on a project called the Open Science Grid (OSG). The fact that these were developed within the Open Grid Services Architecture (OGSA) made them compatible at the basic service level, however the user interfaces were somewhat different. Recently though, a major effort has been made in developing the interoperability between grids so that in the end user with the right credentials can use resources from any service based on any middleware around the world. Thus the possibility of an interconnected global grid infrastructure is starting to become a reality.

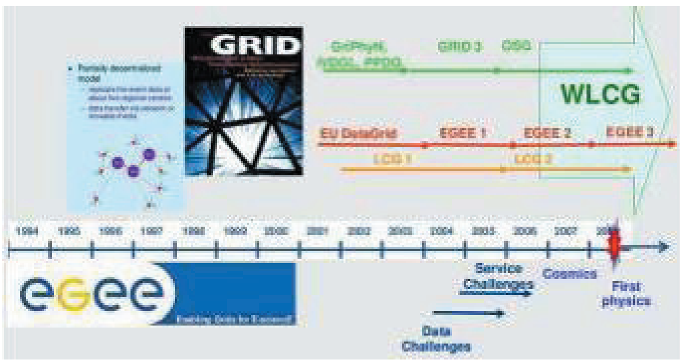

Figure 4: A historic perspective of international grid development, showing the major milestones in significant middleware and infrastructure projects. US-based projects are shown in the green line, while European projects are shown in the red line. Interoperability between the projects from mid-2006 is represented by the Worldwide LHC Computing Grid (WLCG)

Efforts in South Africa to join the ATLAS and ALICE grids have been spared to a large extent the problems surrounding the incompatibilities between grid middleware due to the late stage of participation. With a solid national infrastructure based on high-performance hardware, the potential for a collective decision to deploy a national compute grid along the lines of EGEE was possible. In March 2008, an annual meeting of the tertiary education directors of IT was held and several university IT departments, research heads and laboratory directors decided to commit to the deployment of a prototypical test-bed for grid computing in South Africa. In order to provide a uniform grid infrastructure for reasons of simplicity and scalability, it was necessary to standardise on a given set of tools. A joint decision made by the UCT-CERN Research Centre, iThemba Laboratory for Accelerator-Based Sciences (LABS), the University of the Free State (UFS), Northwest University (NWU), the University of the Witwatersrand, the University of Johannesburg (UJ) and the CSIR Cluster Computing Centre (C4) to deploy grid services based on the gLite middleware stack from EGEE and to form a Joint Research Unit (JRU) for the promotion and organisation of this activity. With dedicated support and training from the Italian National Institute of Nuclear Physics (INFN), sections of Cagliari and Catania, and the Grid INFN Laboratory for Dissemination Activities (GILDA), a series of site administrator training and induction sessions were held in Catania (June '08) and Cape Town (July '08). The first grid sites in South Africa were deployed between June and July at the aforementioned sites. The basic functionality of the services and user interaction with them is shown in Figure 6. Instead of a strictly tiered model as is the case with LCG, a flatter, more modular and strongly federated model was chosen, where there are as few central points of control and failure as possible. The central services controlling workload management (WMS), information and service discovery (top-level BDII) and logical file catalogue (LFC) were installed at the UCT-CERN Research Centre in Cape Town. These services can be replicated at any other site or remote central services can be used by each site deploying computing (CE) and storage (SE) elements. These services for the most part were installed on pre-existing hardware, aggregating a few hundred CPU cores and several TB of distributed storage to the prototype. With this now interconnected infrastructure, South African research could start to imagine the types of collaboration exemplified by the LHC experiments, by sharing their computational resources in a federation of grid sites.

However, the one essential ingredient to a true grid infrastructure was missing: the security infrastructure, based on digital certificates. Currently in South Africa no academic or research organisation exists which is recognised internationally by the International Grid Trust Federation (IGTF). Such organisations, referred to as Certificate Authorities (CA's), issue *personal certificates* to identify individuals as well as *host certificates* to secure the machines which provide the grid services. While this is now being addressed by the Meraka Institute which will host the Certification Authority for South Africa (and will serve a large fraction of sub-Saharan Africa), accreditation to the EUGrid Policy Management Authority (EUGridPMA) which precedes inclusion to the IGTF is a lengthy and delicate procedure, the start of a highly trusted relationship. As a stop-gap measure to speed up deployment of grid infrastructure in South Africa, which relies critically on this security infrastructure, the INFN has appointed two Registration Authorities (RA) in South Africa which act as proxies for the Italian CA. Users and sites in South Africa can therefore immediately start to use the grid by requesting their certificates from the South African Registration Authorities at iThemba LABS or Meraka.

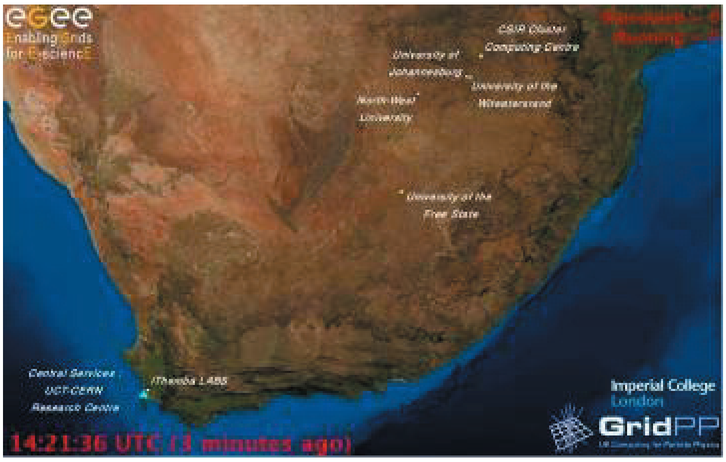

Figure 5: A snapshot of the South African Grid as monitored by the EGEE Real Time Monitor, taken during the user training session at the annual CHPC conference, Durban, December 2008. The map shows functional sites (although no jobs were currently running), as well as the central services at the UCT-CERN Research Centre

The situation in South Africa currently provides the possibility for a phase change in scientific collaboration. The hardware, security and organisational procedures are in place and are being refined to bring them to production readiness. A strong and well-organised national infrastructure provides the platform for South African scientists to significantly participate in international collaborations such as the LHC experiments. However, turning the coin on its head, it provides also a well-defined procedure foreign collaborating scientists and organisations to join South African projects such as the astronomy and Astrophysics areas (SKA, SALT), the space programme, bioinformatics networks and rational drug design, hadron-therapy, materials research, and several engineering projects, to name but a few. SAGrid aims to provide a region-wide support structure, including Regional Operations Centre (ROC) for site and Virtual Organisation (VO) support, which would extend not only to the entire national area of South Africa, but include also groups and individuals in our neighbouring countries. This vision is supported by our international partners, most prominently CERN, the European Commission's Information Society Technology Partnership for Africa, (ISTAfrica) the Italian INFN, the French CNRS and IN2P3 and Spain's CIEMAT. In order to enhance local skills, SAGrid (through the Meraka Institute and the UCT-CERN Research Centre) is a partner in a 4 year, 8 M Euro exchange programme (EPIKH), coordinated by the INFN, Catania and funded by the EU. SAGrid also provides regional support to a multi-million dollar project run by HP and UNESCO to reverse the brain drain in Africa, involving several African and Middle-Eastern countries. As the support base in South Africa grows, so the user base is being encouraged to grow, enacting a virtuous cycle of services and demand, ultimately resulting in the acceleration of South African research and development.

This is the vision of SAGrid: to enable anyone with the right credentials, anywhere in South Africa, to access the entire national (and, if it is the case, international) cyber infrastructure in a uniform and easy-to-use way, and to provide a federated, flexible and dynamic tool for collaboration and research.

If you are interested in joining SAGrid as a user or service provider at your institution, please contact the author or write to sagrid@lists.sagrid.ac.za

Useful links

SAGrid official website : http://sagrid.ac.za

Mailing lists : http://lists.sagrid.ac.za

Wvents and training : http://indico.sagrid.ac.za

GILDA t-Infrastructure : https://gilda.ct.infn.it

EGEE-III website : http://eu-egee.org

gLite Middelware : http://glite.web.cern.ch/glite

ALICE public pages : http://aliceinfo.cern.ch

ATLAS public pages : http://www.atlas.ch

SA-CERN public website : http://sa-cern.ac.za

UCT-CERN Research Centre : http://hep.phy.uct.ac.za

Dr. Bruce Becker is the co-ordinator of the South African National Grid, based at the Meraka Institute, CSIR, Pretoria. He can be emailed at BBecker@csir.co.za.

SAIP & NLC Physics Outreach

Science Unlimited Pretoria 2009

Brian Masara

The South African Institute of Physics partnered with the National Laser Centre (NLC) to participate at this year's Pretoria Chapter of Science Unlimited from 2 to 6 March. Roelf Botha the SAIP Marketing and Outreach Coordinator and Brian Yalisi a student from the NLC represented the two institutes at the event. After hearing about careers in Physics and lasers in everyday life, student competitions were held with winning students winning SAIP branded lollypop pens.

Dr Thomas du Plooy of the NLC presented a lecture entitled "The Wonder of Light and the Application of Lasers" which focused on the use of lasers in our daily life and a few more advanced applications, focusing on the properties of light, polarization, reflection, refraction and diffraction.

Most teachers that participated in the event requested that the SAIP visit their schools during career guidance events.

Those interested in the SAIP & NLC team visiting their area can contact the SAIP Office. Volunteers willing to be part of the South African Physics Outreach team can also contact the SAIP Office.

Brian Masara is the Executive Officer of the South African Institute of Physics. He can be contacted at Email: Brian.Masara@saip.org.za or info@saip.org.za Tel: 012 843 6561

Women in Physics SAFE Travelling Exhibition

Brian Masara

The South African Institute of Physics (SAIP) and the French National Centre for Scientific Research (CNRS) successfully held a workshop aimed at exploring the issues that affect women in science and motivating girls to follow careers in Physics.

The objectives of the workshop were to:

- Launch a travelling exhibition of French and South African women physicists, which would be hosted by science centres countrywide,
- Hold a panel discussion where schoolgirls interacted with Physicist role models

SAFE Women in Physics Travelling Exhibition - Launch

The joint exhibition of women in Physics from South Africa and France was called the SAFE Women in Physics Travelling Exhibition. The project is modelled on the similar initiatives in the United States and Canada in past years. The overall objectives of this exhibition are:

- To attract girls to study Physics at university
- To encourage girls to take up Physics as a career

The travelling exhibition will visit all nine provinces in South Africa and in each province girls will be invited to an open forum discussion on taking Physics as a career.

Participants

The South Africa France (SAFE) Women in Physics Travelling Exhibition was launched with keynote speeches from His Excellency Denis Pettin the French Ambassador to South Africa and Dr Phethiwe Matutu the General Manager for Human Capital and Science Platforms in the Department of Science and Technology. Ms Loreto Motaung (Group Corporate Social Investment Director at Murray and Roberts) was the master of ceremony for the event.

Participants in the launch of the SAFE Women in Physics Travelling exhibition included:

- Women in Physics from South Africa
- Women in Physics from France
- Science Stakeholders from South Africa i.e. Department of Science and Technology, National Research Foundation, Sci-Bono and SAASTA
- Oprah Winfrey Leadership Academy
- Lofentse Girls High

The exhibits are made up of 10 female Physicists from South Africa and 15 female physicists from France. 5 of the women included in the exhibit from South Africa and 2 from France were available at the launch and they spoke to learners about their careers in Physics. Prior to the launch schoolgirls from the Oprah Winfrey Leadership Academy and Lofentse Girls High had an opportunity to interact with the women Physicists present.

Figure 1: Participants from Lofentse Girls High around the exhibit.

Panel Discussion on Women in Physics

The keynote speeches at the launch were followed by a panel discussion on issues affecting women in Physics and issues that girls face in choosing Physics as a career. The panel discussion was started by a presentation of statistics and issues affecting women in Physics from France and South Africa.

The following physicists made up the panel of experts who led the discussion on Physics careers with the participants:

Mmantsae Diale – South Africa

Diane Grayson – South Africa

Anne Corval – France

Anne Pepin – France

Faye – Senegal

Margaret Samiji - Tanzania

Figure 2: A participant from the Oprah Winfrey Leadership Academy asks a question during the panel discussion.

The following recommendations were made based on issues raised during the panel discussion:

- The travelling exhibition should not be static.
- Girls who are interested in careers in Physics should have the opportunity to spend a day with a Physicist to learn about what a Physicist really does.
- Younger role models should be involved in future. These will be the best role-models to attract girls into Physics.
- A document with the profiles of successful Physics professionals be compiled summarising their current research, areas of expertise and contact details. The document will be circulated to all schools for students to contact for career information and to arrange visits, etc.

Call for Volunteers

The next steps are to:

- Arrange a full day of interaction between Physicists and learners
- Finalise arrangements for the travelling exhibition throughout South Africa
- Focus outreach on girls in Grade 9 and below to ensure that Physical Science in chosen in the FET band (Grades 10 to 12).

If you would like to host the exhibition please contact Women in Physics in South Africa (WiPiSA) through the SAIP Office.

Brian Masara is the Executive Officer of the South African Institute of Physics. He can be emailed at Brian.Masara@saip.org.za.

Physics 500

http://www.saip.org.za/physics500/

The Physics 500 Project is the beginning of an attempt by the SAIP to identify and track physicists in Industry.

The aims of the project are:

- To identify industries in South Africa that employ physicists,
- To identify physicists working in South Africa,
- To use this information to promote Physics,
- To promote collaboration between the SAIP and industry.

At present, to qualify as a Physics 500 participant, you must satisfy the following conditions:

- Have at least a B.Sc (Hons) in Physics, or equivalent,
- Be currently working for industry in South Africa.

In this case, industry means any business, especially one that employs physicists. This specifically excludes academic staff at academic/ teaching institutions unless they have an income-sharing arrangement with their institution.

If your current occupation does not specifically use your Physics training, you are still encouraged to complete the survey - your experiences may be valuable to others.

For each issue of **PC**, we will be featuring a Physicist from the Physics 500 project.

Bessie Mmakgoto Makgopa, from Pretoria

Qualifications

In 1998, B.Sc. (Chemistry and Physics) at Rand Afrikaans University (RAU)

In 2002, B.Sc. (Honours), from Physics at RAU

In 2005 enrolled for M.Sc., from Nuclear Engineering at the University of the North West (UNW). Topic: "Simulation of the Irradiation Behaviour of the PBMR Fuel in the SAFARI-I Reactor"

Career

Bessie has worked at the University of the Witwatersrand in the Climatology Research Group (CRG) as a data analyst, at the Atmosphere and Energy Research (AER) as a scientific officer, at Mondeor High School in Science as a science educator and currently works at the South African Nuclear Energy Corporation in the Radiation and Reactor Theory Group as a scientist.

Survey Responses

Why did you originally choose to study Physics at university?

I was inspired by the work of physicists like Sir Isaac Newton and Albert Einstein. These legends did a great work by studying, discovering and formulating the laws that govern the world around us.

Did you enjoy your university Physics? What inspired you about Physics?

I had more passion for Chemistry than for Physics, the chemistry laboratory work used to stimulate me more than Newtonian freefall or electromagnetism. My only inspiration in Physics stemmed from being able to turn theory into practice using very simple equipment to model the physical or real world.

What did you do after graduating from university with your highest Physics degree?

I did some research work in the field of Atmospheric Chemistry and Physics. That led me to get involved with Air Quality Management research work. After I obtained my honours degree, I went into teaching due to job scarcity for Physicists in the country.

What made you choose a career in industry rather than a career in academia?

It was a tough choice for me. Having obtained my B.Sc. (Honours) in Physics *cum laude*, my professors encouraged me to go into academia as they felt that I was better at handling the theoretical aspects than the experimental aspects of Physics. However, I felt that with determination, one could conquer anything. So, for now I have decided to spend some time in industry. After a few years of industrial practice I can perhaps decide to go academia.

When did your industrial career really take off?

My career took off in 2005, when I joined NECSA as a scientist. When at university I studied fundamental Nuclear Physics to some advance courses at honours level, I met a challenge in Nuclear Reactor Physics, a field that I almost never knew it existed. It was a fairly demanding take off, but since I took up studies in Nuclear Engineering, the course work quickly widened my horizons in this field.

What advice do you have for Physics students thinking of embarking on a similar career?

Physics is challenging but interesting and it is a field worth exploring. One has a choice of going into theoretical or experimental Physics. For both streams one needs a very inquisitive mind and high attention to detail.

What advice would you give to university departments to make their Physics teaching and research programmes more useful for industry?

University departments need to keep abreast of the developments in industry (in terms of new technologies employed) and tailor their training such that to prepare the students for a successful career in the industry, should they chose that path.

What are your perceptions about the importance of Physics in present-day society?

I perceive Physics as being very important to society. Society at large must be educated about Physics phenomena and natural processes. There are too many myths around Physics especially Nuclear Physics that is brought upon by lack of awareness.

Vacancies

Convenor and Lecturer, Academic Development Programme / National AstroPhysics and Space Science Programme

Three-year contract position

FACULTY OF SCIENCE

The Faculty of Science at UCT enjoys a high national and international reputation for the quality of its teaching, research and outreach programmes. It comprises thirteen departments: Archaeology, Astronomy, Botany, Chemistry, Computer Science, Environmental and Geographical Science, Geological Sciences, Mathematics and Applied Mathematics, Molecular and Cellular Biology, Oceanography, Physics, Statistical Sciences, Zoology.

The Faculty offers a suite of four undergraduate programmes, leading to the BSc degree. These are

- Information Technology
- Biology, Earth and Environmental Sciences
- Chemical, Molecular and Cellular Sciences

Mathematical, Physical and Statistical Sciences

Postgraduate programmes form an integral and key component of the offerings in the Science Faculty, and are offered at Honours, Masters and Doctoral levels. Masters programmes may be by thesis only, or by coursework and thesis. Examination of the PhD degree is by dissertation only.

CENTRE FOR HIGHER EDUCATION DEVELOPMENT (CHED)

The Centre for Higher Education Development (CHED) is headed by the Dean of Higher Education Development and has an organisational status similar to that of a Faculty. CHED currently comprises the following units: ADP (including the Alternative Admissions Research Project), Career Development Programme (including the Careers Office and the Professional Communication Unit), Centre for Education Technology, Centre for Information Literacy, Centre for Open Learning and the Higher and Adult Education Studies Development Unit. CHED has been established by Senate and Council to focus on all matters concerning academic development.

The vision of CHED is to be a cross-faculty unit that contributes to continual improvement in the quality of higher education through widening access, promoting excellence through equity, developing the curriculum in partnership with faculties, enhancing the competence of graduates by ensuring the provision of key skills and abilities, and enabling systemic improvement through the research-led development of informed policy options.

ACADEMIC DEVELOPMENT PROGRAMME (ADP)

The Academic Development Programme (ADP), the largest of CHED's units, has for two decades represented UCT's central strategy for promoting equity in the student body. Although specialised teaching continues to be an important part of the work of many ADP staff, in recent years, as the diversity of the student intake has increased, the ADP has placed increasing emphasis on working with departments and faculties to design curricula and approaches that integrate AD into mainstream undergraduate provision and allow for economies of scale. There are ADP staff and programmes in all six faculties. The most widely-used and successful ADP strategy for fostering access and success is the "extended curriculum" model, in which substantial foundational provision is articulated with the mainstream curriculum, resulting in a lengthened degree programme that allows educationally disadvantaged students to develop firm academic foundations.

While educationally disadvantaged students continue to face substantial obstacles, ADP programmes have played a key role in enabling the growth of black student enrolment and graduation at UCT, and have achieved some highly encouraging successes.

NATIONAL ASTROPHYSICS AND SPACE SCIENCE PROGRAMME

The National AstroPhysics and Space Programme (NASSP), which is hosted at UCT, is run by a consortium of institutions which offer post graduate programmes at the honours and Masters level in AstrPhysics. These programmes which are funded by the Department of Science and Technology aim to equip students to undertake further research at their home institutions and hence to embark upon careers in AstroPhysics and related fields. Students for these programmes are recruited from both South African Universities and other African Universities and typically will have a B.Sc degree in Physics and / or Mathematics.

NASSP EXTENDED HONOURS PROGRAMME

In an attempt to broaden access to NASSP, in particular to include students from previously disadvantaged communities, an extended version of the present NASSP one year honours programme, over two years, has recently been introduced. The aim of the extended honours programme (EHP), is to provide students with the necessary background and skills that will enable them to engage fully and meaningfully with the present NASSP curriculum.

THE POST UNDER ADVERTISEMENT

The incumbent will convene the NASSP EHP.

The incumbent will be on the Academic Development Programme (CHED) staffing establishment. The line of accountability of the lecturer IS to the NASSP Executive Committee via the ADP Coordinator in Science. It is envisaged that the post will be filled at the level of lecturer, with commencement no later than 1 April 2009.

We are therefore seeking applicants who are adequately qualified and experienced to tackle the educational challenges as well as the ability to teach all or most of the following topics at 3rd year / honours level: Electrodynamics, Special Relativity, Quantum Mechanics, Vector Calculus, Linear Algebra, Fourier Analysis and Introductory Computing.

The NASSP EHP lecturer will be expected to:

Convene and manage the NASSP EHP

Teach and administer the various components comprising the programme

Coordinate the teaching of any "outsourced" modules.

Undertake curriculum design and development

Mentor the students on the programme

Requirements include:

- A PhD degree in Physics, Mathematics, or Astronomy (or evidence of substantial progress towards completion)
- A commitment to educational innovation

Relevant curriculum design and development experience will be advantageous.

Academic Service Conditions – please see http://hr.uct.ac.za/conditions/genlcond.php

UCT reserves the right to make no appointment at either level within this process.

Student Opportunities

Post-graduate research in Nano-science and Nanotechnology at Wits

We are developing a programme dedicated to research in nano-electronics under the broad area of experimental condensed matter and materials Physics in the School of Physics, at the University of the Witwatersrand, Johannesburg. Under the clean room environment we are constructing some state-of-the-art facilities for measurements of electronic device transport in nano-scale and device fabrication integrated with nano-materials synthesis for the first time within the African continent. For nano-device characterization we are employing a fully automated cryogen-free cryostat (measuring at temperatures down to 300 milli Kelvin and magnetic fields up to 12 Tesla), other liquid helium based cryostats to achieve even lower temperatures and also a cryogenic probe station (measuring at temperatures down to 4 K, at 2.5 T magnetic fields and at high frequencies up to 67 gigahertz). For nano-materials synthesis we use a pulsed YAG laser combined with a furnace and a hot-filament CVD system. Mainly the National Research Foundation under the National Nanotechnology Flagship Programme and also National Nanotechnology Equipment Programme funds these projects. Within the School of Physics and Materials Physics Research Programme we use a wide range of materials characterization tools including micro-Raman (JY T64000 triple spectrograph), TEM (with EELS), Focused Ion Beam, multimode AFM, diffractometers, ion implanters etc. We also work in close association with the DST/NRF Centre of Excellence of Strong Materials and in close collaboration both with neighboring universities in our city and with premier national research institutes in near proximity and internationally. The ongoing research activities of the group are based on three closely related projects.

Project I: Synthesis of nano-materials for nano(opto)-electronics and spintronics

We synthesise one and two-dimensional carbon superstructures and semiconductor nanowires by laser ablation and CVD techniques. In order to develop electronic devices, under this project, electronic transport in a range of low-dimensional carbon superstructures e.g. quantum wells, nanocrystalline diamond, graphene and also superlattices of nanotubes are being studied.

Project II: Nano-electronics of low-dimensional carbon and related semiconductor superstructures

This project focuses on the measurements of electrical (magneto-) conductance in carbon superstructures (at 300 mK and 12 T) and novel device characterization at 4 K, 2.5 T and 67 GHz frequency.

Project III: Computational nano-electronics of carbon nanostructures related to high-speed transport

We shall investigate high-speed quantum transport in 2D carbon including graphene and carbon quantum wells and also in 1D semiconductor (metal incorporated) nanowires and functionalized nanotubes.

Recently we have started this programme with the involvement of a graduate student and a post doctoral fellow in synthesis of nano-materials and characterization of nano-electronic devices, respectively. Two other post-doctoral fellows from overseas are joining the group within a month to participate in project II and III. We are also actively looking for an expert at the post-doctoral level in device Physics. At this time we seek highly motivated students for research at the post-graduate and doctoral level in order to enrich the activities for our group and offer a unique training programme in nano-science and nanotechnology. Bursaries for students are available from the National Nanotechnology Flagship Programme for 2009 onwards for all these projects.

Successful candidates will be expected to work in at least one of the following areas: Synthesis of carbon and semiconductor nanostructures, electronic-magnetic characterization of low-dimensional carbon films and quantum wells, measurements of Hall and magneto-resistance in carbon tunnel devices and nanotubes.

Prospective applicants should contact Prof. Somnath Bhattacharyya:

Tel: +27 (0)117176811, Fax: +27 (0)117176879, Email: Somnath.Bhattacharyya@wits.ac.za

http://web.wits.ac.za/Academic/Centres/StrongMaterials/CarbonNanotubesandStrongComposites/Members/Bhattacharyya/

Opportunities for Students: International Year of Astronomy 2009 (IYA 2009)

For those students who have an interest in astronomy or even just a sense of wonder about our universe, IYA2009 offers various opportunities. Students can get involved in astronomy through astronomy outreach and other activities around the country, or even helping with developing astronomy resources. For more information, visit the IYA webpage at: www.astronomy2009.org.za or contact Kevin Govender (e-mail: kg@saao.ac.za).

Conferences & Winter Schools

11th Neutron and Ion Dosimetry Symposium (NEUDOS-11)

iThemba LABS (Laboratory for Accelerator-Based Sciences) is hosting the 11th Neutron and Ion Dosimetry Symposium (NEUDOS-11) in Cape Town, South Africa from 12-16 October 2009. The Symposium is being held under the auspices of the European Dosimetry Group (EURADOS).

A comprehensive scientific program, encompassing a full range of neutron and ion dosimetry topics, will be offered. Delegates will enjoy an interesting and varied social program. Accommodation will be available in or near the impressive Victoria and Alfred Waterfront shopping, hospitality, and entertainment complex.

All information regarding registration, accommodation and submission of abstracts is now available on the website (www.neudos11.tlabs.ac.za). Note that in order to prevent the necessity of parallel sessions, papers for oral presentation will be selected by the Scientific Committees. Those not selected will have to be presented as posters. The proceedings of NEUDOS-11 will be published in a special edition of the journal *Radiation Measurements.* Full information regarding the submission of manuscripts will be available on the website once the abstract refereeing and oral presentation selection processes are complete.

The deadline for both abstract submission and application for financial support (African delegates only) is 30 April 2009 and for early registration it is 30 June 2009. Online registration will be available from 15 March 2009.

SAASTEC Conference 2009

The 2009 SAASTEC Conference will be held in Sutherland, Northern Cape in honour of IYA2009 from 23 – 27th November 2009. The dates of the conference include 2 days of travelling by bus from the MTN Sciencentre in Cape Town to Sutherland. The conference proper is from 24-26th November 2009. The first announcement will be sent out at the end of March. All information will also be posted on the SAASTEC website (http://www.saastec.co.za/)

Contact SAASTEC Secretary/Treasurer Ginny Stone (squigglez@telkomsa.net) for more details.

9th World Conference on Neutron Radiography

The 9th conference in the series of World Conferences for Neutron Radiography (WCNR-9) has been scheduled by the International Society for Neutron Radiology (ISNR) to take place in South Africa in 2010. More information about WCNR-9 may be obtained from http://www.wcnr-9.co.za/ OR http://www.ISNR.de.

Alternatively, contact Frikkie de Beer (Chairman of Local Organising Committee of WCNR-9) at Tel: +27 (0) 12 305 5258 / 5007 / 5985, Email: Frikkie.DeBeer@necsa.co.za

MEDICAL PHYSICS: ANNUAL CONGRESS OF SAAPMB

We have pleasure in announcing the official website of the 48th South African Association for Physicists in Medicine and Biology at

http://www.saapmb2009congress.co.za.

The Congress is from 24 to 28 March at the University of the Free State and is being held in the CR Swart Building on the Bloemfontein Campus. We have a full program and several international speakers who will be presenting work mainly in fields around Radiotherapy Planning Physics, including Tumour Imaging, Image Guided Radiotherapy and Radiation Biology.

The full provisional program is now available on the web site. We are looking forward to welcoming you at the University of the Free State in Bloemfontein, South Africa, March 2009.

Antarctic Science Winter School

An Antarctic Science Winter School for Honours BSc students will be held at the Hermanus Magnetic Observatory from 13 to 17 July 2009. The school will include lectures and practical workshops in the following disciplines:

- Biology,
- Oceanography,
- Geomorphology, and
- Physics.

Students wishing to attend should apply by 15 May 2009 at

http://moodle.hmo.ac.za

A colour poster for the school is available at

http://chinstrap.ukzn.ac.za/school-poster.pdf

Successful applicants will be notified by 18 May 2009 and will receive:

- transport to Hermanus;
- accommodation and meals.

Where: Hermanus Magnetic Observatory

P. O. Box 32, Hermanus, 7200, South Africa

When: 13 to 17 July 2009

Apply: http://moodle.hmo.ac.za

Contact

Andrew Collier abcollier@hmo.ac.za 083 3813655

Jennifer Lee jlee@sun.ac.za 021 8082835

David Hedding heddidw@unisa.ac.za 082 8576047

Brett Kuyper brett.kuyper@gmail.com 072 1984401

54th Annual South African Institute of Physics Conference

The 54th Annual Conference of the South African Institute of Physics (SAIP) will be held from Tuesday, 7 July to Friday, 10 July 2009, at the University of KwaZulu- Natal (Westville Campus), Durban. Two Winter Schools will be held concurrently on Monday, 6 July - "Southern Skies" to commemorate the International Year of Astronomy and "Quantum Information, Processing and Communication". Further information will become available in the second announcement due to be

released at the beginning of March 2009.

Details can be found on the conference website:

http://saip2009.ukzn.ac.za

All enquiries should be forwarded to the Conference Organisers.

Conference Organisers

Room 119 GSB Innovation Centre

Tel: (031) 260-1584/1182/1604

email: saip2009@ukzn.ac.za

Committee Members

Prof. F. Petruccione (Chairperson: Organising Committee)

Dr. M. Moodley (Chairperson: Scientific Programme)

Dr. A. Matthews

Dr. K. Moodley

Prof. T. Konrad

Mr. N. Chetty

Prof. S.R. Pillay